Smart Sensor Developers' Kit
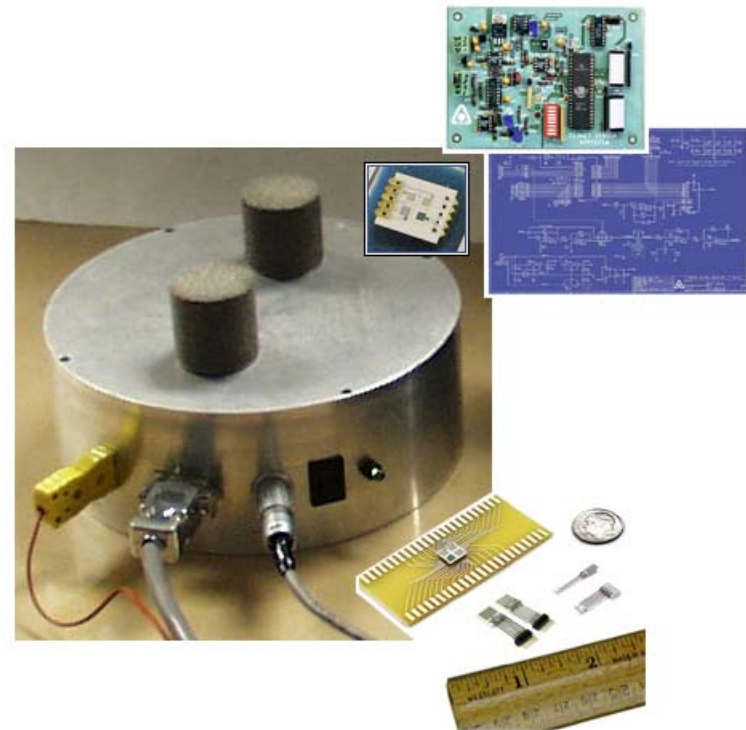
R&D100 Award Winner for 2002

Developers

Michael Vogt (ANL)

Laura Skubal (ANL)

Erika Shoemaker (ANL)

John Ziegler (GA)

What it is

The smart sensor developer kit is a user-configurable, active-sensor, gas detection technology that can be incorporated into a wide range of instruments for a variety of applications. As such, this unique *enabling* technology can allow manufacturers to begin offering *wide-range, high-end gas detection and identification capabilities* even in consumer applications, such as fire detectors and termite sensors. *(this is PR verbage, please remember that)*
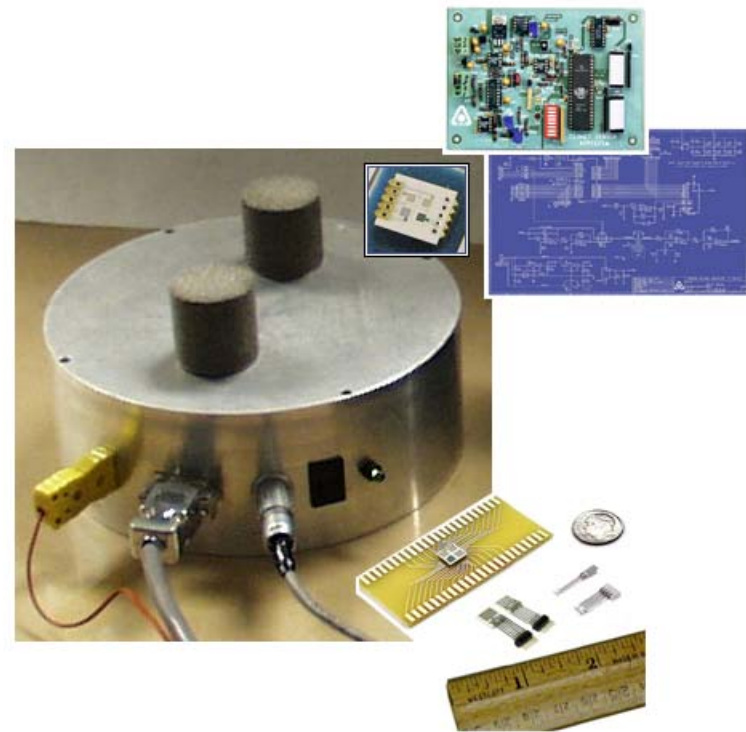
Background

- **10+ year history at ANL**
- **Research at ANL had developed and tailored the cermet sensor technology for enough applications that it was *distilled* into a collection or "kit" of parts, each with its own role and type of flexibility**

1995-1996

2000-2001

1996-1999

1990-2001
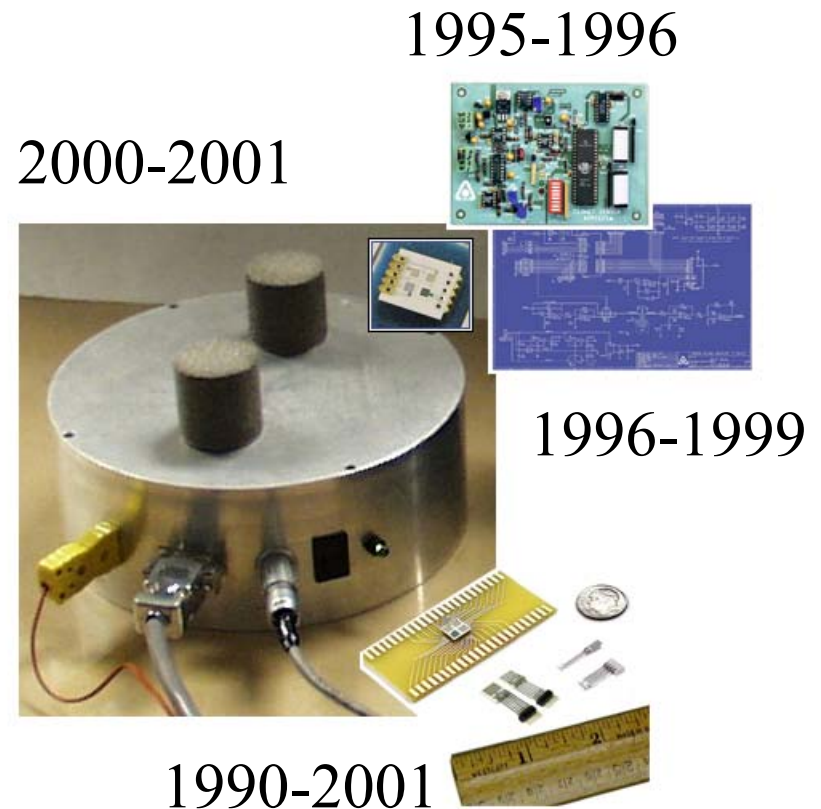
"Kit" Components

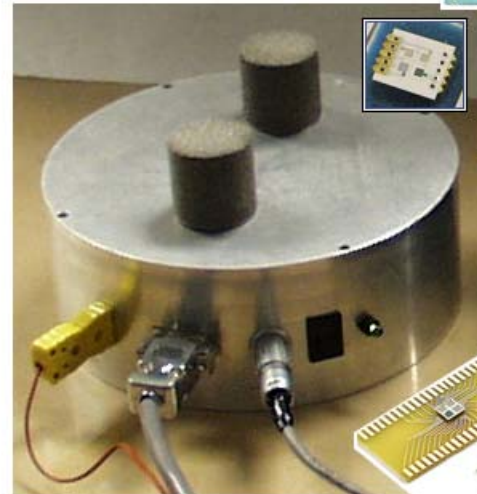**Kit serves as the heart of a "smart" gas sensor application and includes…**

- Specialized cermet microsensor elements

- Programmable electronics

- Flexible analysis

Measurement
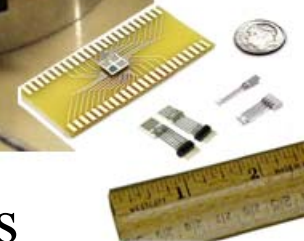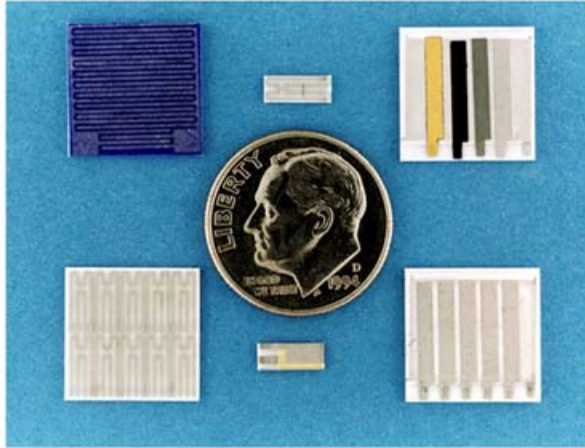
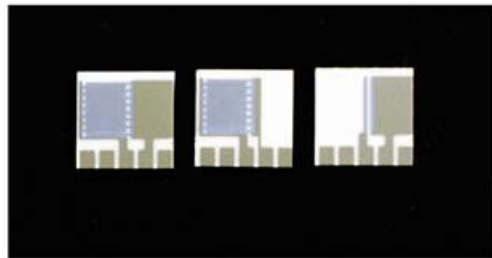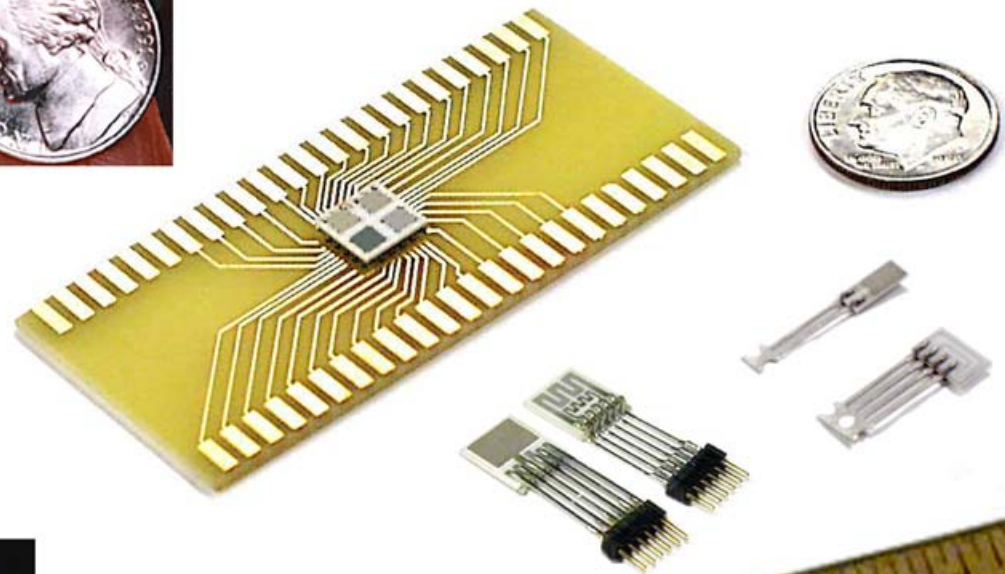Applications

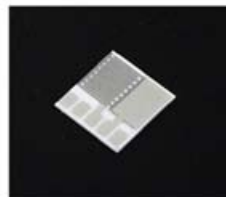Analysis

Sensors

Microsensors and Arrays

Smart Sensor Developer's Kit (SSDK)

Electrocatalytic devices (voltage-excited)

Photocatalytic devices (light-excited)
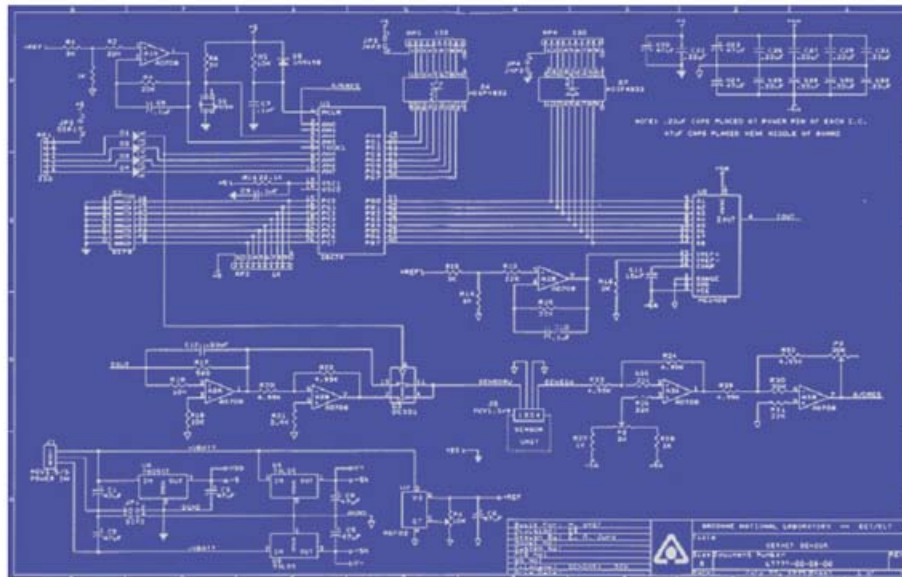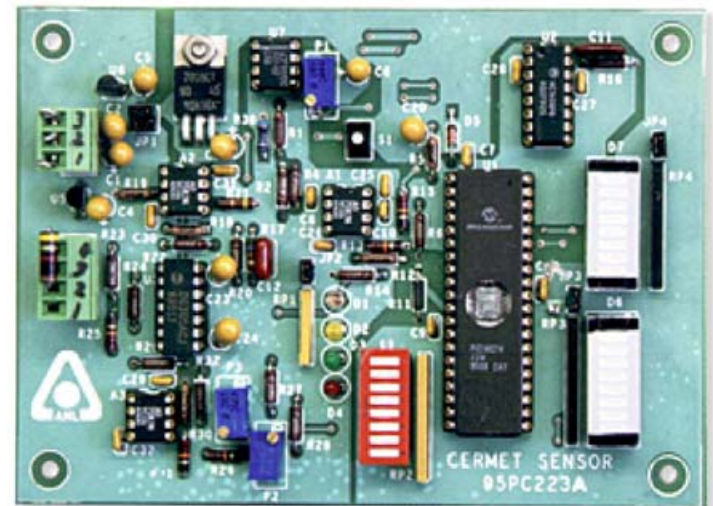
All devices shown to same scale

Electronics Support

Smart Sensor Developer's Kit (SSDK)

DIP microcontroller electronics
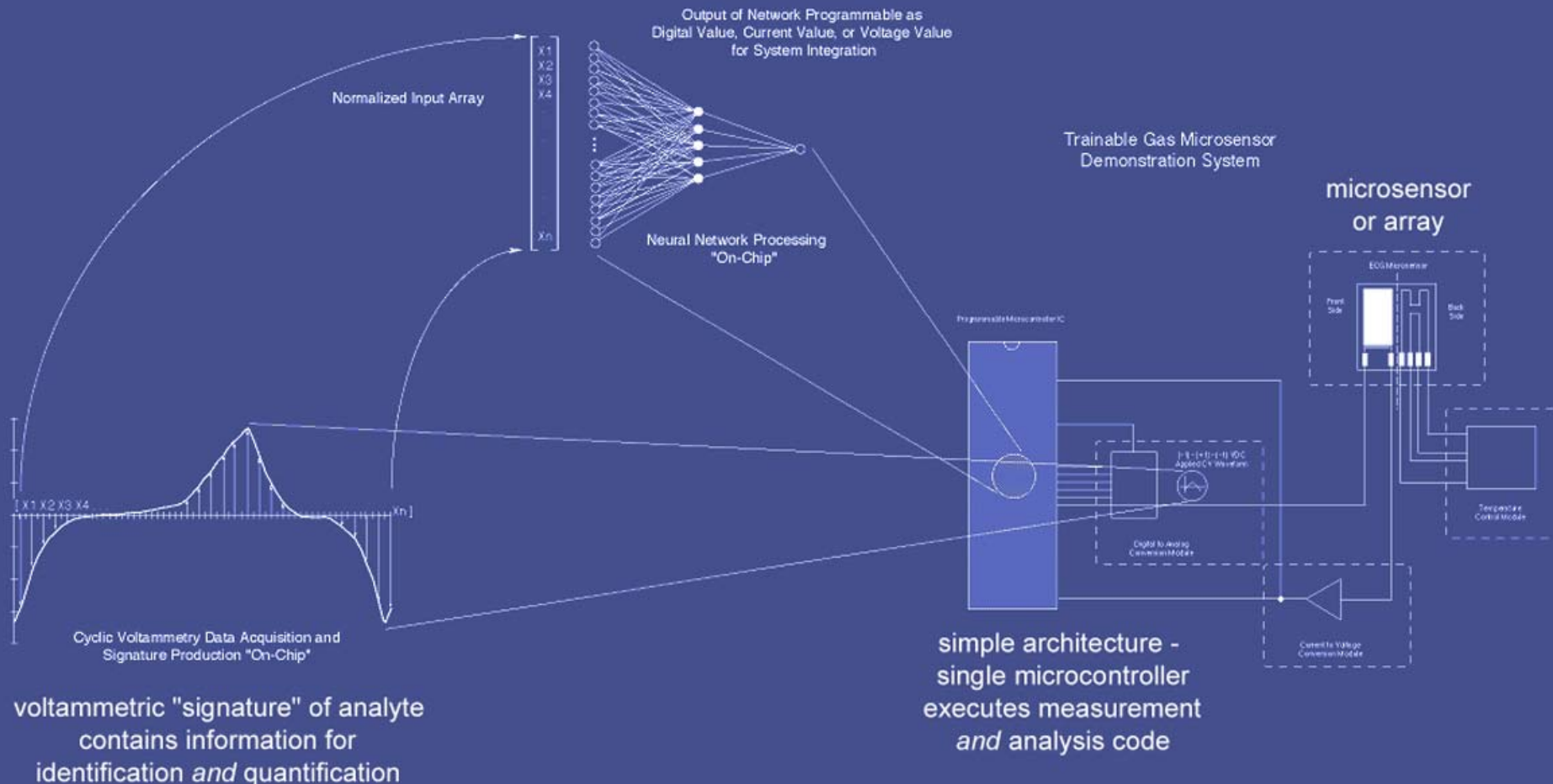
Schematics

SOIC microcontroller electronics

Both devices shown to same scale

Theory Of Operation

Smart Sensor Developer's Kit (SSDK)

Output of Network Programmable as
Digital Value, Current Value, or Voltage Value
for System Integration

Normalized Input Array

X1
X2
X3
X4

Xn

Neural Network Processing
"On-Chip"

Trainable Gas Microsensor
Demonstration System

microsensor
or array

Programmable Microcontroller IC

[X1 X2 X3 X4   Xn]

Cyclic Voltammetry Data Acquisition and
Signature Production "On-Chip"

voltammetric "signature" of analyte
contains information for
identification *and* quantification

simple architecture -
single microcontroller
executes measurement
and analysis code
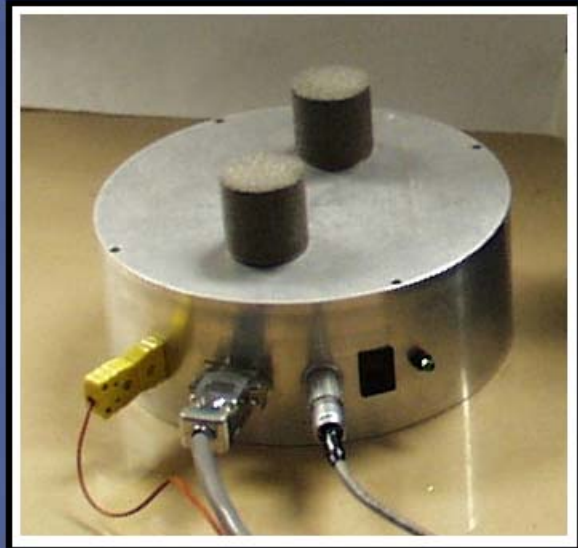
Demonstrated Application

Intelligent fire-detection funded by General Atomics

- **Sponsored high temperature components and systems development, then adopted the results for an intelligent fire detector. That detector was successfully demonstrated to the US Navy (DCARM program) in live fire-detection testing aboard the EX-USS Shadwell**
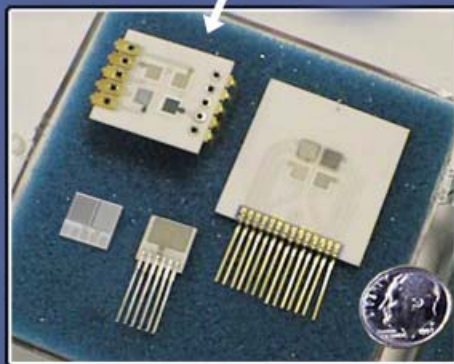
Outside of case shown slightly smaller

General Atomics Corp.

Smart Fire Detector

SOI fire detector shown at same scale as microsensors

Current Developments

Insect Pest Infestation Detection funded by RSC/Terminix

- **Developing a instrument and methodology to detect termites by their characteristic off-gassing. Field tests have already been successful**

Air Pollutant Monitoring funded by US Army SERDP

- **Developing a network of inexpensive emissions monitors and a strategy for deployment and measurement of emissions from DoD operations**